

enacted in accordance with the Administrative Procedures Act. The Commission cannot, as it has attempted, evade this procedural requirement by altering Section 15.5(b) indirectly through modification of Part 90.³⁷ Moreover, the non-rebuttable presumption of non-interference is at variance with Title III of the Communications Act, inasmuch as the Commission has not fulfilled its statutory duty to protect licensed stations from harmful interference caused by unlicensed operation.³⁸ The new un rebuttable presumption also creates a dangerous precedent in other bands where Part 15 devices share the spectrum with licensed services.

Accordingly, Pinpoint urges the Commission to eliminate the requirement of MTA licensees to demonstrate that they will not cause unacceptable levels of interference to Part 15 devices. If there is to be testing however, such testing should also assess the potential for Part 15 devices to degrade, obstruct, and interrupt multilateration LMS operations. In addition, the FCC should make the presumption against harmful interference from Part 15 devices rebuttable and limited to heights of 5 meters or less, including those cases where Part 15 is the "final link"³⁹ for entities eligible under Subparts B and C of Part 90. However, if the Commission extends the presumption to antennas with heights of up to 15 meters, the

³⁷ *Greater Boston Television Corp. v. FCC*, 444 F.2d 841 (D.C. Cir. 1970), *cert. denied*, 403 U.S. 923 (1971).

³⁸ 47 U.S.C. §§ 301 and 302.

³⁹ Pinpoint requests clarification of the meaning of "final link." Pinpoint is concerned that this undefined language may extend the un rebuttable presumption to myriad uses of Part 15 devices not contemplated in the record of this proceeding. Pinpoint also notes that the FCC has provided absolutely no reasoning supporting the inclusion of this language in its new rules. Until clarified, Pinpoint can not assess the impact of this rule and reserves the right to seek further reconsideration.

attenuation formula should be as follows: $R = 90 \log(h/5)$ dB, where R is the required reduction in dB of power from the maximum permitted, and h is the height in meters.⁴⁰

VI. THE COMMISSION'S REQUIREMENT FOR MULTILATERATION LMS EQUIPMENT AUTHORIZATION SHOULD BE EXTENDED GIVEN LIKELY MODIFICATION OF TECHNICAL RULES IN THE RECONSIDERATION PROCESS

The *Order* requires that "all LMS equipment imported or marketed after April 1, 1996, must be type accepted."⁴¹ Pinpoint respectfully requests that any equipment authorization requirement for multilateration LMS be extended until 12 months after any final rule on reconsideration, and that all radios imported or *manufactured* prior to that date be exempt regardless of when they are used. The Commission also should clarify that LMS providers may indefinitely continue to use equipment deployed prior to the type-acceptance deadline provided that it is not marketed after the deadline (whether the deadline is April 1, 1996 or a later date).⁴²

Given that Pinpoint asks the Commission to revisit its emission mask requirements as urged herein, such an extension is appropriate. In the absence of an extension, multilateration LMS licensees that have designed their equipment and deployed systems on an

⁴⁰ In any event, the FCC should make clear that the obligations under new Rule Section 90.361(c)(1) to reduce power when antenna gains exceed 6 dBi and Section 90.361(c)(2)(ii) to adjust transmitter power at heights above 5 meters are cumulative. Hence, an antenna at 10 meters with 9 dBi gain must reduce its output power below 1 watt by 3 dB under Section 90.361(c)(1) and an additional 6 dB under Section 90.361(c)(2)(ii).

⁴¹ *Order* at ¶ 88.

⁴² The concept of "marketing" has traditionally included "importation." 47 C.F.R. Section 2, Subpart I.

expedited basis in order to meet the Commission's grandfathering deadlines may be required to redesign their systems. Such a scenario could result in significant stranded investment and would not further the public interest in the development of a vibrantly competitive LMS market.

VII. CONCLUSION

Pinpoint believes that the public interest in the development of a viable and, indeed, robustly competitive LMS market -- a market that includes small entrepreneurial competitors -- requires modification of the *Order* as set forth above. Only by so doing will the FCC attain its goal of ensuring that LMS systems play an important role in providing valuable service to the American public.

Respectfully Submitted,

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Report on the Uniplex - Pinpoint Time-Sharing Demonstration in Washington, DC

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Executive summary

Since the beginning of the LMS rulemaking, Pinpoint has maintained that because of the "time-slicing" inherent in the vehicle polling and/or calibration schemes common to AVM systems, time-sharing is a simple and effective means for spectrum sharing among different AVM systems.

In September 1994, Uniplex stated on the record that it also considered time-sharing to be feasible. In January of 1995, Uniplex and Pinpoint undertook to demonstrate their assertion about the simplicity and effectiveness of timesharing between two AVM systems of radically different design.

Within a few days of the decision to show the feasibility of timesharing, a real, live operational demonstration of the two systems operating without interference to each other in a simple round-robin time-slicing fashion was assembled and operational in Washington DC.

The demonstration showed that it is indeed possible for very different AVM systems to reliably co-exist in the same geographical area, using exactly the same segment of AVM spectrum, without the requirements for exclusive spectrum or the "major system redesigns" argued by some AVM proponents.

This demonstration shows that there is not a need to auction all multilateration spectrum. Rather, the FCC could provide a sub-band for LMS operators who would share the sub-band. Creation of a shared sub-band would fulfill the FCC's statutory obligation to attempt to avoid mutual exclusivity and, thus, the need for competitive bidding. Moreover, a shared sub-band would further the public interest in efficient and competitive LMS service by encouraging small entrepreneurial multilateration developers to deploy spectrally efficient systems.

At the very least, the demonstration proves that the Commission's decision to require sharing among grandfathered multilateration systems using the same sub-band in the same markets is sound. Moreover, the FCC's requirement that grandfathered systems and MTA auction winners share is also fully justified.

Historical Background of the Demonstration

Since the commencement of the LMS rulemaking, Pinpoint has maintained the feasibility and desirability of time-sharing as *the* mechanism for spectrum sharing between diverse LMS service providers. At the end of September 1994, Uniplex Corporation stated on the record that it also considered time-sharing to be feasible.

Following major, but ultimately unsuccessful, attempts during the last four months of 1994 to arrange tests to experimentally assess the interference potential between Part 15 devices and LMS systems, Pinpoint and Uniplex began discussing their mutual interest to conduct a time-sharing test in Washington D.C. Late in January, after a few over-the-phone discussions, Uniplex came to Washington DC to deploy a small system for purposes of conducting time sharing experiments in conjunction with the Pinpoint experimental system already deployed there.

Within 5 days, the Uniplex system was deployed and was time sharing with Pinpoint's experimental system, using a simple two second per user, round-robin time-slicing scheme. After another day of adjustment, the time slice durations were further reduced; Pinpoint's by 75% and Uniplex's by 50%; to assess the effects on overall system performance.¹ It was clear to both parties that because the existing software managing their systems had not been specifically designed for cooperative timesharing, with more time to further develop the necessary software, it would be possible to reduce the duration of the time-slices even further, thereby reducing the effects of timesharing on individual system's performance.

Description of the Time-Sharing Demonstration

Demonstration overview

The two systems were set up to provide coverage of the Washington Mall and portions of the George Washington Parkway adjacent to the Potomac River (see FIG 1). For reasons of convenience and to expedite the demonstration, the four roof top sites already used by the Pinpoint system were selected for the Uniplex base station equipment. A base station for each company's system, each with its own separate antenna, was deployed as in a typical installation on these rooftop sites. Each system operated independently except for a single hardwire connection that, for ease of rapid implementation, provided the common system timing reference selected for the demonstration.

¹ The time-sharing demonstration was activated on January 26 through February 3, 1995, and again on February 16, 1995. Unfortunately, on the last date, the remote terminal display of one of the systems was not operational. However, on this day, as on all other days on which the time-sharing demonstration was activated, the time-sharing mechanism operated successfully to avoid inter-system interference.

The Pinpoint base station hardware was selected to be the source of the time-sharing timing signal. A simple "square wave" was programmed at the output of a spare RS232 port, synchronous with the common time used among the Pinpoint base stations. Pinpoint and Uniplex agreed that when the square wave was "high," Pinpoint could use the "air" and when the squarewave was "low," Uniplex could use the "air." Note that while Pinpoint generated the signal, both systems monitored the squarewave as though it were generated by a "third party" source. It could have been generated by any one of many possible sources, such as GPS time, etc.

No guard bands were inherent in the sharing arrangement itself; any guard band that either operator desired came from within that operator's time slice. These guard bands typically already exist within each system to different degrees, usually to avoid intra-system interference. There is no reason that larger guard bands would be needed on an inter-system basis in a time-sharing environment.

Mobile units for each system drove around in the Washington D.C. coverage area to provide live interaction with the Pinpoint ARRAY™ and the Uniplex SpyderNet systems.

Pinpoint's ARRAY™ Network

The Pinpoint ARRAY™ Network (shown in FIG 2A) consists of a Network Control Center located in Dallas, TX that is connected via telephone modem to the four base stations located in Washington, DC. The Pinpoint demonstration presented the location and data information to a remote PC running a mapping application at the live demonstration point in Washington, DC.

The Network Control Center (NCC) manages the system operation and interfaces customer application systems, to the corresponding application systems connected to TransModem mobile radios in the target vehicles, transparently performing protocol conversions as required. It contains a set of parallel processors that jointly perform all control functions. The NCC controls and schedules all transmissions from the base stations to the TransModem mobile radios. It estimates the position of each TransModem from the relative arrival time of the TransModem mobile radio's message signals received at the base stations using both linear and hyperbolic multilateration techniques. It manages the base stations and assures that their internal time references are coordinated among the base stations.

ARRAY™ base stations incorporate fixed radio transmitters and receivers, along with ancillary equipment, including a high-gain vertically polarized antenna. Base stations transmit polling and message data to TransModem mobile radios under the control of the NCC and receive polling-responses and message transmissions from the TransModem mobile radios; each base station accurately determines the arrival time of the received messages (with nano-second resolution) and forwards the received messages with its "time-stamp" to the NCC for message processing/routing and vehicle-location determination. The NCC communicates the data-message and/or location information to the remote application.

Communications from the base station are organized into a repetitive "system cycle," which is a frame of information divided into several different functional segments. Time sharing is accomplished by the NCC changing the scheduling and control of the network's interactions that occur during the system cycles, in response to the availability signaled by the "external standard" time-sharing timing signal.

Uniplex's SpyderNet Network

The UNIPLEX Spydernet System, shown in FIG 2B, consisted of four base stations co-located with the Pinpoint system's base station equipment². The network architecture allows PC applications to access the network via modem to query for the location of the vehicle.

The network control computer initiates a token passing session at regular intervals, wherein a packet of information is passed between all pairs of base stations that can "hear" each other. All mobiles that can overhear 3 or more pairings of towers can calculate their position in Latitude and Longitude. In addition they receive information contained in the data packet such as the Lat/Long of each fixed point, road and traffic updates and lists of units being "paged" by individual address or area. A mobile answers a page or initiates a call by calling the nearest base station and establishing a link to its particular host computer.

To accomplish sharing, each Uniplex base station received the timing signal from the co-located Pinpoint base station, (a convenience for this demonstration as explained above). Each of the Uniplex base stations locally modified its operation in response to this signal.

Discussion of the results

The demonstration showed the simplicity and ease of setting up the most basic time-sharing scheme: fixed-interval, round-robin time-slicing. The scheme only required a common timing signal and an agreed upon schedule for accessing the spectrum.

While Pinpoint generated the timing signal for the purposes of these experiments, that did not make the Uniplex system "slave" to the Pinpoint system -- it was merely an experimental convenience. There are many potential sources of acceptable time signal that can be used by all systems sharing time in the band. They could come from sources such as GPS, WWVB, FM Subcarrier, the public switched network or supplied by one of the time sharing systems. These different methods could be either wired connections between the system, wireless or a combination of both.

In a non-time-shared environment, as two or more systems become heavily loaded their RF collisions rates increase until neither system operates efficiently or with any certainty. The

² The co-location was solely to facilitate the temporary setup of the facilities. There is no need for the base stations of time sharing systems to be co-located.

heavier the load the more RF collisions and the longer the latency between the time a user requests service and the time the request is successfully completed.

Systems using time-sharing, on the other hand, operate so as to have no concern of RF collisions from other systems; they are operating in spectrum clear of the transmissions from the other time-sharers. Also, user requests for service are not affected and latency is determined by each system and its performance parameters and not by competing systems. The Pinpoint and Uniplex demonstration shows that it is practical to set up time sharing between medium and high location capacity systems.

The time share demonstration between Pinpoint and Uniplex showed that, in a short time and with minor adjustments, two systems designed in complete isolation could share the spectrum at different agreed upon rates. The demonstration itself was sharing at 0.5 sec and 1 second. Other sharing rates tested were one second and one second, and one second and two seconds. All of these times were selected for quick and easy setup of a demonstration. Given a specific sharing method and a more realistic development time period, sharing periods could be reduced to almost any practical level needed for appropriate service performance and a multiplicity of providers.

While this demonstration was based on very simple, fixed interval, round-robin time-slicing, other options could be developed for even more effective use of the "air-time" resource. For example, since the service demand is usually "real application" driven, the nature of the demand for airtime from all operators is likely to be variable and randomly intermittent. Thus, it could be that at a particular moment one operator's time-slice could be partly fallow, while the other's could be experiencing delays because of over-demand, and vice-versa, at another moment. With a higher level of real-time interaction between time-sharing parties, it could be possible to make the sharing arrangement more flexible, while maintaining the spirit of equal opportunity.

For example, time sharing efficiency could be improved by taking the sporadic demand for airtime into account over all operators, instead of it being taken into account by each operator independently, as naturally occurs with simple round-robin time-slicing. This could be accomplished by an (independent) Arbitrator (box) agreed to by all participants. It could more dynamically manage time sharing from air-time access-requests made by each participating service provider. The arbitration provider would develop the specification and obtain agreement on the method for (dynamic) time sharing, acquire or produce, operate, and maintain the equipment needed to supply the sharing signals. Such an Arbitrator could even monitor RF signals and help determine when sharing systems were properly operating within the agreed-upon access intervals. Whether such an approach makes sense within any given area should be left up to those licensees in the sharing group.

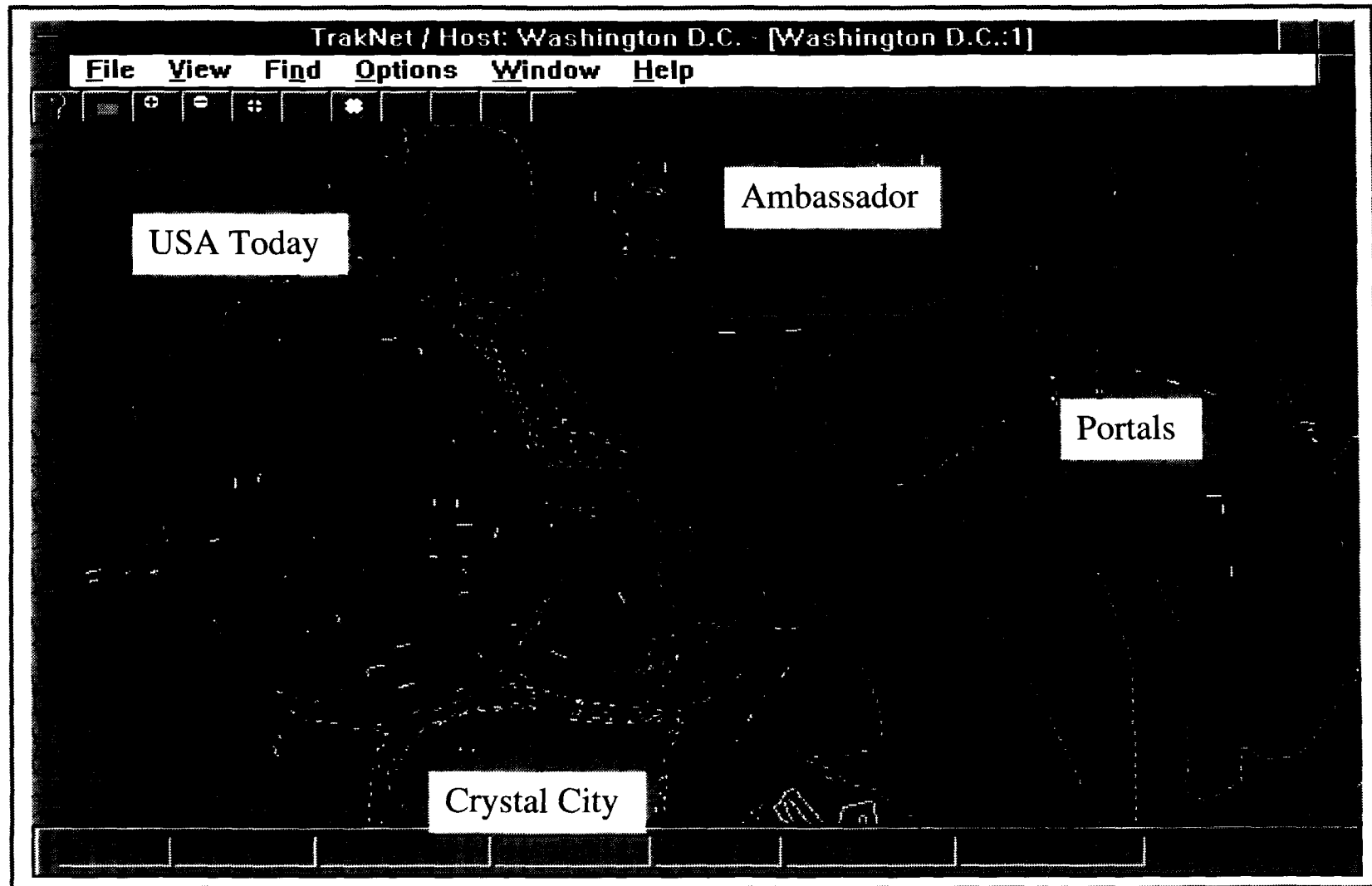
Conclusions

This demonstration has shown that time sharing is indeed feasible among LMS service providers. It further showed that it could be done simply and quickly. All that was required

was an agreed-upon time-standard signal-source and a protocol by which that timing signal would be used to gain access to the spectrum.

This demonstration provides support to the conclusion that it is not necessary to auction all of the LMS spectrum, and that the public interest would be well served by the allocation of a band segment for LMS service providers who could time share their access to the spectrum. At the very least, the demonstration shows the soundness of requiring grandfathered multilateration systems to share with other grandfathered systems and MTA auction winners.

Physical Layout



Pinpoint and Uniplex Colocated at Each Site

Figure 1

System Configurations

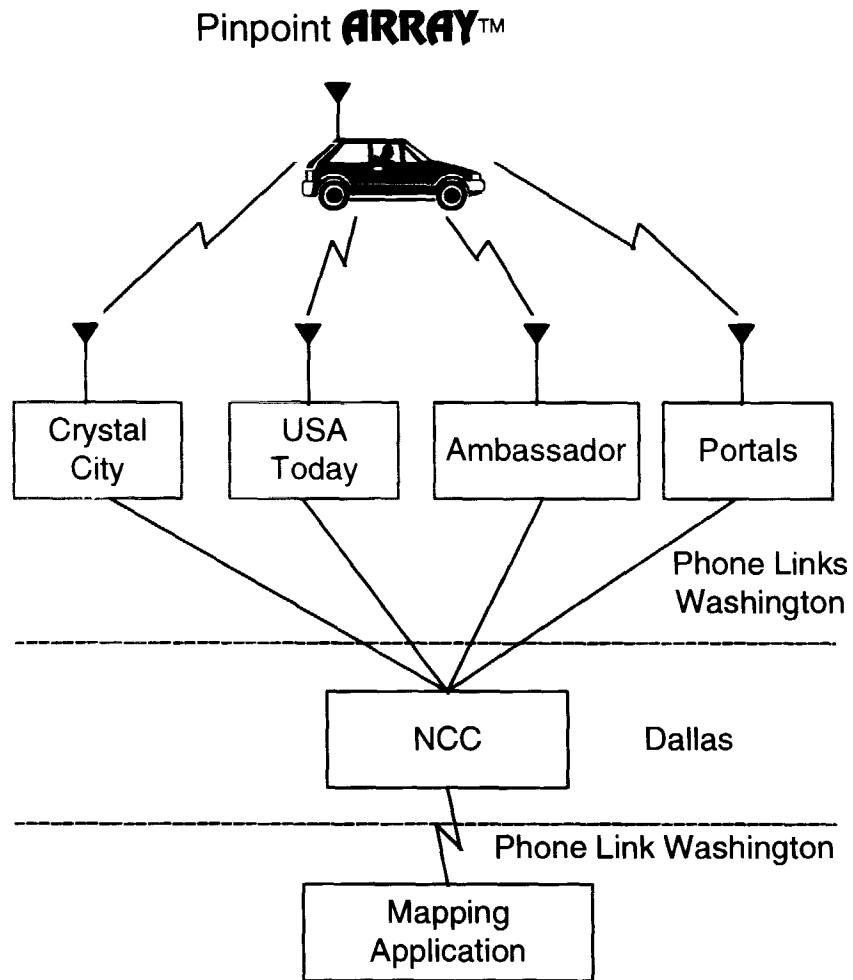


Figure 2A

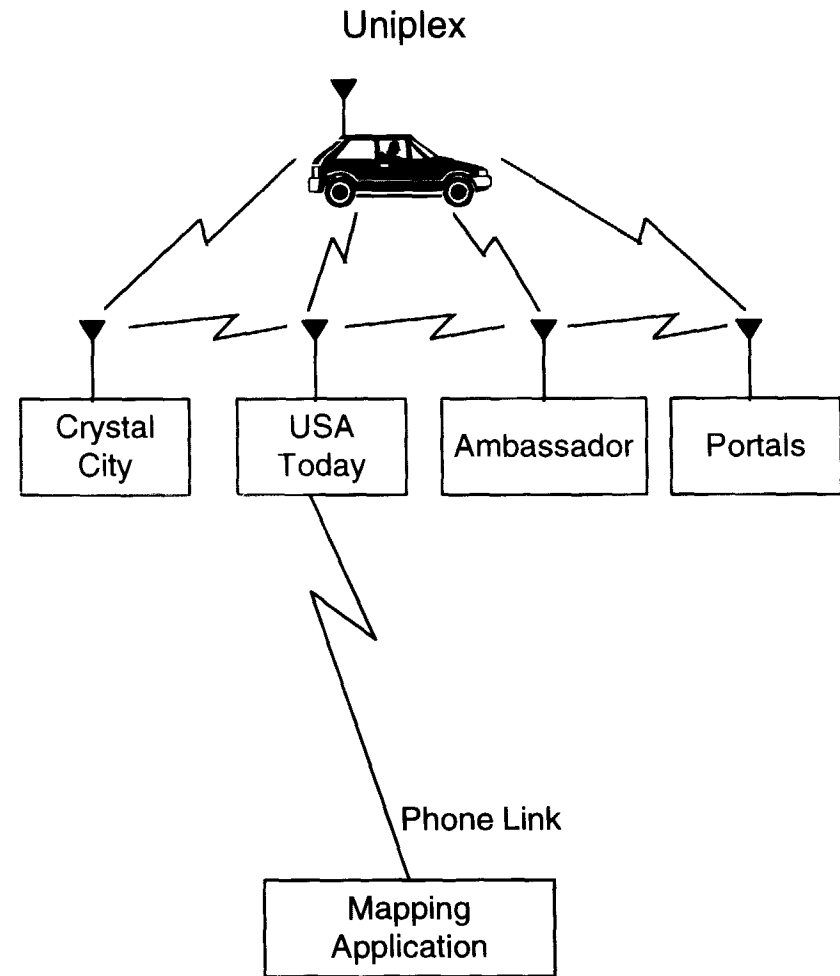


Figure 2B